VI. SPORT AND WELLBEING TECHNOLOGIES
VI. СПОРТ И ЗДОРОВЬЕСБЕРЕГАЮЩИЕ ТЕХНОЛОГИИ

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CONTROL OF ATHLETE'S PHYSICAL CAPACITY

Abstract: Physical capacity is the most important condition of developing all basic physical qualities, the basis of athlete's ability to withstand intensive specific workload, and, to a great extent, determines athletic performance on every major stage of multi-year sports training. Evaluation of athlete's physical capacity along with identification of its prevalent energy supply mechanisms is a valuable information, which allows to control the training process on a qualitatively higher level. This article addresses the role of physical capacity in the system of sports training and the method of physical capacity evaluation.

Key words: physical capacity, sports training, training influence, muscular energy supply, respiration.

High physical capacity is essential in achieving high level of athletic performance. It is characterized by a variety of objective factors such as functional capacity of muscles and autonomic systems, output, capacity and efficiency of energy supply mechanism, condition of musculoskeletal, endocrine systems, etc. However, considering this diversity of factors, the only way to increase long-term physical capacity of an athlete is exercise stress, which causes an adaptive response of functional body systems. In sports practice, exercise stress is caused by the motional task. Establishing that motional task is one of the most important professional objectives of a coach.

The most important feature of a motional task is its focus on increasing athletic performance. As it increases, the arsenal of training exercises, methods and means of training involved must increase as well.

Their classification by pedagogical, psychological, psychophysical, physiological, biochemical, biomechanical attributes is described in detail in works of many authors [2, 7, 9, 12, 15]. Yet it is impossible to establish the system of sports training on the basis of the above determinants ignoring targeted integration of their relationships. In order to create such a system of sports training, it is imperative, in all of its complexity and diversity, to identify a single training component, which directly causes the training effect. This is the training influence, which is determined by the motional tasks, and, at the same time, determines them as well [2, 4, 5, 6]. V.B. Korenberg (2004) considers training influence to be «an influence of a physical, physiological or psychological factor, which causes the desired adaptive reaction, leading to increase in functional, technical or psychological (in general athletic) performance»[11]. Therefore, for the purpose of setting up motional task, it is appropriate to arrange this multitude of determinants of sports training into three generalized irreducible groups of factors:

1) mental states and psychological processes;
2) ratios of aerobic and anaerobic energy supplies;
3) neuromuscular regulation (movement technique and tactics) [6].

Ratios of aerobic and anaerobic energy supplies of physical activity are constantly changing depending on the stage of training. However, during the multi-year process of sports training, larger percentage of which consists of prolonged monotonous workload, a sort of «metabolic stereotype» was observed to form. It is responsible for a certain degree of inflexibility of functional systems regarding adaptive responses. For example, longtime speed-skating athletes have intensified anaerobic energy supply even while exerting moderate power. This happens because of the nature of speed-skating athletes' sports activity, which involves mostly strength and speed. And the other way around: race walking athletes have inhibited anaerobic energy supply, and therefore they are unable to adjust to higher workload. Intensification of anaerobic energy supply mechanism, usually caused by excessive exercise stress, will lead to a decrease in physical capacity and, consequently, to deterioration of workload tolerance, up to the point of breakdown. Therefore, control of athlete's physical capacity is advisable.

Physical capacity clearly illustrates athletic performance. Measuring physical capacity, predicting its trend, and increasing it is another important professional objective of a coach. Among its determining factors

the most significant one is aerobic capacity, defined by oxygen consumption during workload [8, 14, 16]. However, direct measurement of oxygen consumption requires specialized equipment for quantitative analysis of expired air. This leads to a number of difficulties, which limit applicability of this method in everyday sports practice, such as: high requirements for qualification of the staff, maintaining that equipment, relatively high cost of expendable supplies for gas analysis, difficulty of pedagogical interpretation of measured biomarkers. Conducting gas analysis in field conditions is complicated as well. Thus, there is a demand for biological indicator, which is possible to measure by a wide range of researchers. Obviously, this indicator must be directly related with the physical exertion level, allowing to clearly reflect physical capacity of an athlete.

External respiration clearly illustrates physical exertion level [3]. Measurement of respiratory minute volume (MV) allows monitoring of oxygen consumption. It is demonstrated in the data of Girandola R.N., Katch F.I., Henri F.M. (1971), which shows strong correlation between oxygen consumption and respiratory minute volume if high physical exertion level on cycle ergometer is maintained [13]. In addition, the increasing demand for oxygen caused by an oxygen debt, which manifests during intense physical exertion, also contributes to respiration [3, 16]. According to the above, it is possible to reflect the physical capacity as the ratio of respiratory minute volume (MV, l/min) to the power exerted by the athlete (P, watt). This ratio is the first derivative of respiratory minute volume with respect to power (dMV/dP), or specific respiratory volume (SV, ml/watt). It can be used as an indicator of determinants of athlete's physical capacity. This physical quantity measures an amount of the air respired in order to exert a unit of power. In order to evaluate functional capacity, it is appropriate to divide specific respiratory volume by athlete's weight (ml/watt*kg).

The equipment required is simple and available: cycle ergometer with variable resistance, heart rate monitor, and spirometer.

The method of measuring (evaluating) athletes' physical capacity is measuring MV during last 20 seconds of each workload stage in cycle ergometry test, which is described thoroughly in numerous works [1, 8, 10]. Specific respiratory volume was calculated and its trend was identified. The end point of testing was decided according the angle of SV

trend, significant increase of which signals about entering decompensated anaerobic zone.

This method allows obtaining determinants of physical capacity, among which are:

– *Specific respiratory volume,* divided by athlete's weight (approximately 3,0 ml/(watt*kg) in aerobic zone), based on which functional capacity of athlete is evaluated and compared).

– *Specific respiratory volume trend*, which describes prevailing muscular energy supply mechanisms (aerobic or anaerobic), formalized as an angle (or a tangent of that angle) of a SV trend (difference in SV divided by an increment of power between the same stages). Energy supply type formed under training influences allows evaluating the training methods used.

– *Anaerobic threshold power* (high level athletes have approximately 3,0 watt/kg). Characterizes physical capacity of an athlete. Measured when SV trend angle starts to rapidly increase.

– *Anaerobic threshold heart rate* for reference during the training process.

This particular method not only allows to measure physical capacity, but also to evaluate prevailing energy supply mechanisms. It gives an opportunity to analyze methods of sports training used, make short-term predictions and correct the training process if needed.

The results of a given research were successfully implemented in the training process of athletes of various level and kinds of sport.

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УПРАВЛЕНИЕ ФИЗИЧЕСКОЙ РАБОТОСПОСОБНОСТЬЮ СПОРТСМЕНА

Аннотация: физическая работоспособность спортсменов является важнейшим условием для развития всех основных

физических качеств, основой способности организма к преодолению высоких специфических нагрузок и во многом определяет спортивный результат практически на всех основных этапах многолетней подготовки спортсмена. Оценка её уровня и определение преобладающих механизмов её энергообеспечения является ценной информацией, позволяющей осуществлять педагогический контроль в спортивной тренировке на качественно более высоком уровне. В данной статье рассматривается роль физической работоспособности в системе спортивных тренировок и методика её оценки.

Ключевые слова: физическая работоспособность, спортивная тренировка, тренирующее воздействие, энергообеспечение мышечной деятельности, легочная вентиляция.

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